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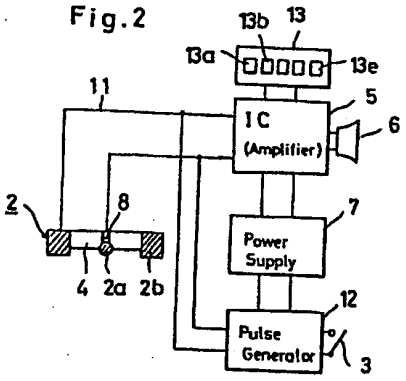
(54) **Electro-therapeutic device.**

(57) In an electro-therapeutic device, a pair of electrodes which are placed in contact with skin are disposed in a handheld housing. The electrodes are coupled to an electronic circuit which can detect a decrease in resistance in the skin, thereby locating a low-resistance point such as an acupuncture point or biologically active trigger point. The electronic circuit also includes a pulse generator which applies a stimulus to the electrodes and stimulates the low-resistance point.

Fig.2



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ELECTRO-THERAPEUTIC DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to an electro-therapeutic device, and more specifically to an electro-therapeutic device capable of detecting electrically low-resistance points such as acupuncture points or biologically active trigger points by applying the device to the surface of the skin and capable of stimulating them for a short period.

Description of the Prior Art

It is well-known that an appropriate stimulation on low-resistance points of the body can give a relief from pain, relaxation or health promotion etc.. In the prior art, many electro-therapeutic devices are known which efficiently work for the low-resistance point stimulation, but conventional devices are relatively expensive, complex, bulky and generally require a trained person to operate. Moreover, the points of the body to be stimulated by such devices are very difficult for an untrained person to locate, thereby requiring a trained person or at least causing an untrained person to make a rough approximation.

Another disadvantage of such prior art devices is that they require two separated electrodes. One of the electrodes must be held by the person to be treated and the second electrode is held and manipulated by the operator of the machine. It can be appreciated that when the person to be treated operates the prior art devices himself it presents an awkward or clumsy situation. All genuine prior art devices in this category use separate detecting and stimulating electrodes which cause electrical current to travel through the body from one electrode to the other, thereby stimulating hundreds of low-resistance points and passing through vital organ's tissues unnecessarily.

Accordingly, there is a need for a simple portable electro-therapeutic device which can overcome these disadvantages, detect low-resistance points on the body, be easily efficiently operated by the user, and limit itself to stimulation of only those points required for treatment.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an easy to use portable electro-therapeutic device that allows the user of the device to treat himself.

In accordance with the present invention, an electro-therapeutic device includes a hand held housing having a pair of electrodes disposed at one end. The electrodes are placed in contact with the skin and an electronic circuit coupled to the electrodes is capable of detecting a decrease in the resistance of the skin, thereby identifying a low-resistance point. The electronic circuit further includes a pulse generator which applies via the electrodes a stimulus to stimulate the identified low-resistance point.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more apparent from a consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a partially broken away front view of the device of the present invention;

Fig. 2 is a schematic block diagram of the electric circuit for low-resistance point detection and stimulation;

Fig. 3 is a cross-sectional view of the electrodes;

Fig. 4 is a diagram of the electric circuit for generating a stimulating pulse;

Fig. 5 is a schematic block diagram showing another embodiment of the electric circuit for low-resistance point detection and stimulation;

Figs. 6 and 7 are respectively a perspective view and a bottom view showing another embodiment of the present invention;

Figs. 8 and 9 are respectively schematic diagrams each showing another embodiment of the electric circuit for low-resistance point detection and stimulation;

Figs. 10 to 14 are cross-sectional views each showing another embodiment of electrodes for low-resistance point detection and stimulation;

Fig. 15 is a cross-sectional view of another embodiment of electrodes whose distance can be adjusted;

Figs. 16 to 19 are respectively a front view, a side view, a top view and a bottom view showing another embodiment of the device of the present invention;

Fig. 20 is a cross-sectional view taken along the V - V line in Fig. 17; and

Fig. 21 is a diagram of the electric circuit used in the embodiment of the device shown in Figs. 16 to 19.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 1 and 2 show the first preferred embodiment of this invention. In Fig. 1, an electro-therapeutic device of the invention includes a housing 1 which is shaped as slenderly as a pen and provided on its one end with a low-resistance point sensor including a center electrode 2a and an outer electrode 2b. The outer electrode 2b is disposed around the center electrode 2a spaced by an insulative material 4. Each electrode is composed of a metal such as stainless steel and is 2 to 6 mm in diameter. These two electrodes 2a, 2b are disposed so closely as to be arranged in one unit.

The center electrode 2a is connected through a spring contact 8 and a lead wire 10 to an IC circuit 5 including a DC amplifier, while the outer electrode 2b is connected to the same circuit 5 through a lead wire 11. The IC circuit 5 is powered by a battery 7 and its output is applied to a speaker 6 (or a lamp etc.). The IC circuit 5

is further connected to an indicator 13 including light emitting diodes (LED's) 13a to 13e. For example, the indicator 13 is constructed to indicate a resistance between the electrodes 2a and 2b, so that LED's are turned on successively in response to a decrease of the resistance. Alternatively, all the LED's can first be turned on and turned off successively one by one with each stimulation on a low-resistance point.

The electrodes 2a, 2b are connected to a pulse generator 12 which produces a pulse in response to an operation of a switch 3 disposed on the outside of the housing 1. The pulse generator 12 includes two transformers T_1, T_2, a transistor Q_1, a capacitor C_1 and two diodes D_1, D_2 as shown in Fig. 4.

All the components including the IC circuit 5, the battery 7, the speaker 6 and the pulse generator 12 are accommodated within the housing 1, but the sound emitting portion 1c of the speaker 6 appears on the surface of the housing 1.

In operation, an operator searchs a low-resistance point by holding the housing 1 with the sensor 2 placed in contact with his or his patient's skin. A current of approximately 0.2 micro A then flows through the electrodes 2a, 2b. When the electrodes 2a and 2b are located just upon a low-resistance point, the resistance between the two electrodes decreases, for instance, from 100M ohm to 100K ohm. This decrease in resistance activates the IC circuit 5 which drives the speaker 6 and indicator 13 so that the detection of the point may be audiovisually indicated. The operator then operates the switch 3 for stimulation.

The operating of the switch 3 causes the transistor Q_1 to be turned on, so that a current flows

through the primary winding of the transformer T_1, and a boosted current flows through the diodes D_1, D_2 and the capacitor C_1 connected to the secondary winding thereof. The diodes D_1 and D_2 are made conductive or non-conductive in dependance upon the charge on the capacitor, thereby generating a pulse with a predetermined duty factor in the secondary winding. Since the secondary winding of the transformer T_1 is connected to the electrodes 2a, 2b, the pulse is applied to the low-resistance point to stimulate it. The stimulation can be adjusted by variable resistor R_1 which varies the pulse frequency, that is, the output energy for stimulation.

Thus, the operation of the switch 3 at the time of detection of a low-resistance point causes an electric pulse (piezo-current about 1 micro A) to be generated, which flows through the detected low-resistance point to give a comfortable stimulation on the low-resistance point.

The switch 3 can be automatically turned on to apply the voltage through the electrodes when a low-resistance point is located.

Fig. 5 shows a preferred embodiment of this automatic detecting and stimulating operation. In Fig. 5, if a low-resistance point is detected, the detection signal is amplified through the IC circuit 5 to activate a comparator 14 with the detection displayed by the indicator 13. This causes the switch 3 to be operated to generate the pulse for stimulation by the circuit as shown in Fig. 4.

Figs. 6 and 7 show another preferred embodiment of the device in accordance with this invention. The electrotherapeutic device in Fig. 6 includes a housing 21 which is shaped to be able to be attached to a user's finger by having the finger inserted through an opening 21b at its

front end, so that the user can make the detection with ease. The housing is provided at the top end with a low-resistance point sensor 22 including a center electrode 22a and an outer electrode 22b disposed around the electrode 22a with both the electrodes separated by an insulative material 24. Similarly as mentioned before, each electrode is made of a metal such as stainless steel 2 to 6 mm in diameter. These two electrodes 22a, 22b are disposed very closely to form one unit, but preferably spaced away from each other at a distance shorter than at least about 3cm.

The center electrode 22a is connected through a spring contact 8 and a lead wire 30 to an IC circuit 25, while the outer electrode 22b is connected to the same circuit 25 through a lead wire 31. The IC circuit 25 is powered by a battery 27 and its output is connected to a speaker 26 (and/or a lamp). The electrodes are also connected parallel to a series connection of a piezoelectric element 23 and a lamp 29 such as LED. All the components including the IC circuit 25, the battery 27 and the speaker 26 are accommodated within the surface 21a of the housing 21, but the sound emitting portion 21c of the speaker appears on the surface thereof.

In operation, the user searches a low-resistance point by inserting one of his fingers into the opening 21b with the sensor 2 placed in contact with his or his patient's skin. A current of approximately 0.2 micro A flows through the electrodes 22a, 22b to the skin. If the electrodes 22a and 22b are located just upon a low-resistance point, the resistance between the electrodes decreases, for instance, from 100M ohm to 100K ohm. This decrease of resistance actuates the IC circuit 25, which then powers the speaker 26 to indicate the detection for the low-resistance point. The operator then actuates the piezoelectric element 23 mounted on the side of the housing 21 to make a

stimulation. The actuation of the piezoelectric element causes the generation of a stimulus in the form of an electric pulse (piezo current of approximately 1 micro A), which flows through the electrodes 22a, 22b into the detected low-resistance point to give a comfortable stimulation thereon. At the same time, the LED 29 is turned on for indication.

The speaker 26 could be replaced by an optical element such as an LED to visualize the low-resistance point detection. It can also be possible to drive the piezoelectric element automatically to apply a voltage between the electrodes upon the detection as mentioned above. Further, the electrodes can be driven at the time of detection by another power source instead of the piezoelectric element.

As a stimulating power source, a power source such as a laser oscillator, infrared LED or ultrasonic generator can be used as shown in Fig. 9, in which the power source 31 driven by a power supply 30 is provided. The automatic or manual closing of a switch 33 upon detection by the sensor 22 causes a light or sound oscillation. The emitted stimulus from the oscillator 31 is led through an optical fiber 32 into the electrodes 22a, 22b arranged as one unit to stimulate the detected low-resistance point. This stimulus is so weak that there will be no harm to the patient's skin.

The detection of the low-resistance point is made using very low (0.2 micro Amp.) current and will cause hardly any pain or unpleasantness to the patient. Both the detection and stimulation are performed by the same electrodes. This allows very efficient and effective treatment. The use of the piezoelectric element or laser oscillator as a stimulating power supply makes it possible to make a comfortable electric stimulation on the low-resistance

points.

In the foregoing embodiments, the electrodes are shown to be coaxially and circularly arranged. However, the electrodes can be formed in any other shape. For example, an outer electrode 40 can be interrupted by gaps 40a arranged in equally spaced relationship as shown in Fig. 10. Alternatively, an oval, rectangular, or triangular electrode 40 can be provided as shown in Figs. 11 to 13. Fig. 14 shows another embodiment in which the electrodes are constructed as two parallel stripes 40, 41.

Furthermore, the electrodes 40, 41 do not always need to be exactly disposed in coaxial arrangement. The center or outer electrode can be disposed with a certain offset. Only the requirement is that the outer and center electrodes are closely disposed at a distance spaced away preferably less than 1 to 3 cm.

In each embodiment, it can be appreciated that the electrodes can be adjusted in distance. As shown Fig. 15, an adjusting screw 50 penetrating through the outer electrode 2b is provided which can reach the center electrode 2a, so that the distance between the electrodes 2a, 2b can be adjusted by adjusting the screw 50.

Referring now to Figs. 16 to 20, there is shown another embodiment of the present invention. The device in this embodiment includes a relatively slender housing 100 fabricated from plastic or other suitable material which is shaped to fit comfortably in the user's hand. A clip 111 is attached to the housing 110 to allow the electro-therapeutic device to be carried in a pocket. A pair of LED's 116, 117 and switches 112, 113, 118 which allow the user to operate the device are disposed in the housing 100. A pair of electrodes 114, 115 are disposed at the bottom of the

housing 100.

Fig. 20 illustrates in cross section coaxial electrodes 114, 115 of the present invention. The coaxial electrodes are separated by an insulative material (including air) and are designed to be placed in contact with the user's skin. Preferably, the center electrode 115 is about 1 mm in diameter and the outer electrode 114 is about 4 mm in diameter.

Fig. 21 shows a schematic diagram of an electronic circuit coupled to the coaxial electrodes 114, 115. The electronic circuit includes a 3V DC power supply 120, which is activated by a switch 112.

A DC 0.2 micro A current then flows to the electrodes 114, 115. When the electrodes 114, 115 are placed over a low-resistance point, there is a resistance differential or a decrease in resistance between the two electrodes which activates amplifier 123a. An activated output signal from the amplifier 123a, 123b is applied to illuminate a green LED 117, to sound a buzzer 126 and to operate a buzzer circuit which includes an amplifier 123d. When a low-resistance point is thus located, the switch 118 is depressed activating a pulse generator which includes transformers T_4. The pulse amplitude of the pulse generator can be changed by switch 113 to either a higher or a lower setting.

After stimulation of the low-resistance point, skin resistance changes. This change may be sensed by the amplifier 123c which in turn activates LED 116, and can provide an indication that the low-resistance point's resistance has been sufficiently changed to indicate that treatment is finished. This procedure may be repeated for other low-resistance points as desired.

Thus, it can be appreciated that a user of the present device merely has to hold the housing 100 and keep the electrodes 114, 115 in contact with a portion of a human body as he moves the device over the body. A very weak electric current (about 0.2 micro Amp.) flows over the human skin between the center electrode 115 and the outer electrode 114. When the electrodes 114, 115 come directly over a low-resistance point where electric resistance is much less than other areas (which varies between 100M ohm and 100K ohm), such variation in resistance is indicated by the sound of buzzer 126 and the LED 17. The user then pushes the switch 118 to send a pulse to the low-resistance point. The pulse is emitted between the electrodes 114, 115.

It can also be appreciated from the foregoing that the device of the present invention has several advantages over prior art devices. The entire instrument is small and lightweight and very easy to handle. The detection of a low-resistance point is made using very low (0.2 microamp.) current and will cause hardly any pain or unpleasantness to the patient. Both the detection and the stimulation are done by the same electrodes which allow very efficient and effective treatment. The degree of stimulation is adjustable in order to give the exact amount of required stimulation. Since both detection and stimulation are provided by the same electrodes, the construction of the instrument is very simple and also prevents the unnecessary flow of electric current to places other than the desired low-resistance points.

While the invention has been described in its preferred embodiments, it is to be understood that the words which have been used are words of description rather than limitation, and that changes may be made within the purview

of the appended claims without departing from the true scope and spirit of the invention in its broader aspects.

CLAIMS

1. An electro-therapeutic device for detecting an electrically low-resistance point for applying a stimulus thereto, comprising:

a housing;

a pair of electrodes, which are disposed in said housing and placed in contact with skin;

means coupled to said pair of electrodes for detecting a decrease in the resistance of the skin contacting said electrodes; and

means coupled to said pair of electrodes for applying a stimulus to the skin when the decrease in resistance has been detected.

2. A device according to claim 1, wherein said pair of electrodes includes a first electrode surrounded by an insulative material which is in turn surrounded by a second electrode.

3. A device according to claim 2, wherein said first and second electrodes are coaxially disposed in said housing.

4. A device according to clam 2, wherein said first and second electrodes can be adjustable in distance.

5. A device according to claim 2, wherein said second electrode is circular, oval, rectangular or triangular.

6. A device according to claim 2, wherein said second electrode is interrupted by gaps.

7. A device according to any of claims 1 to 6, wherein said housing is shaped in the form of a slender pen and provided with a clip which allows said housing to be carried in the user's pocket.

8. A device according to any of claims 1 to 6, wherein said housing is shaped to be attached to the user's finger.

9. A device according to any of claims 1 to 8, wherein said means for detecting a decrease in the skin further includes means for providing the user of said device an indication that the low-resistance point has been located.

10. A device according to claim 9, wherein the indication is provided by a light emitting diode.

11. A device according to claim 9, wherein the indication is provided by a sound producing device.

12. A device according to any of claims 1 to 11, wherein said means for applying a stimulus includes a pulse generator for generating an electric potential.

13. A device according to claim 12, wherein said means for applying a stimulus includes a pulse generator comprised of transformers.

14. A device according to claim 12, wherein said means for applying a stimulus includes a pulse generator for generating a stimulus in the form of heat, light or ultrasonic wave.

15. A device according to any of claims 1 to 14,

wherein said stimulus is automatically applied to the skin when the decrease in resistance has been detected.

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Fig.1

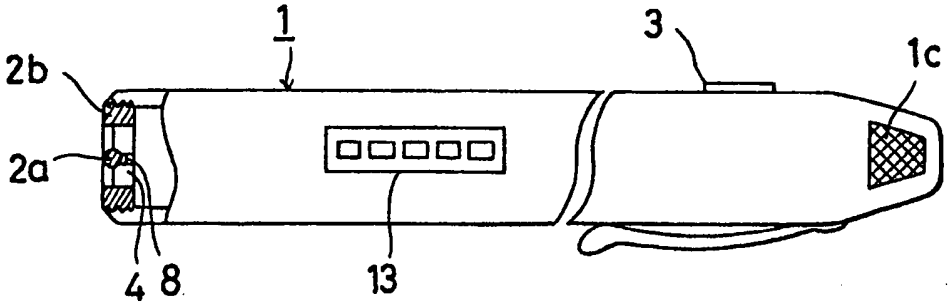


Fig.2

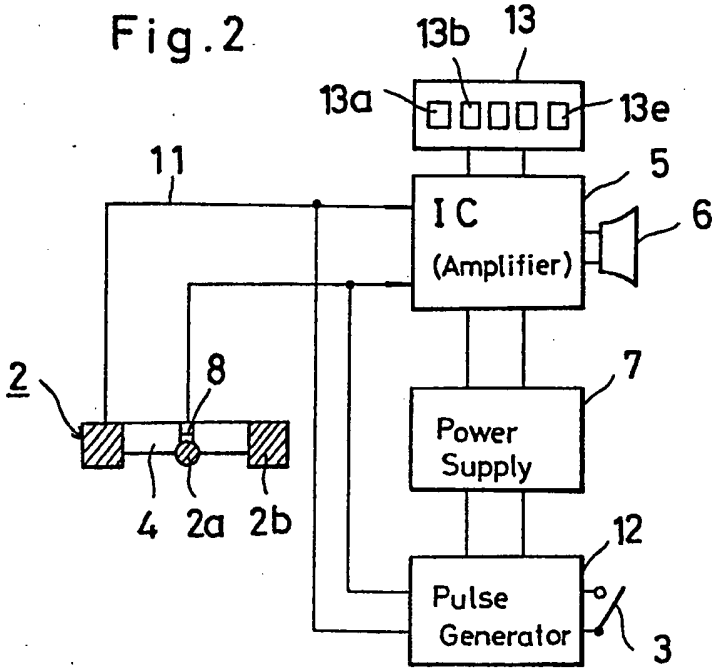


Fig.3

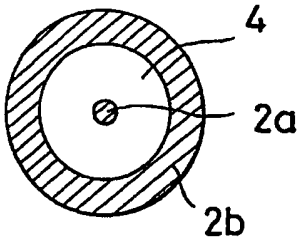


Fig.4

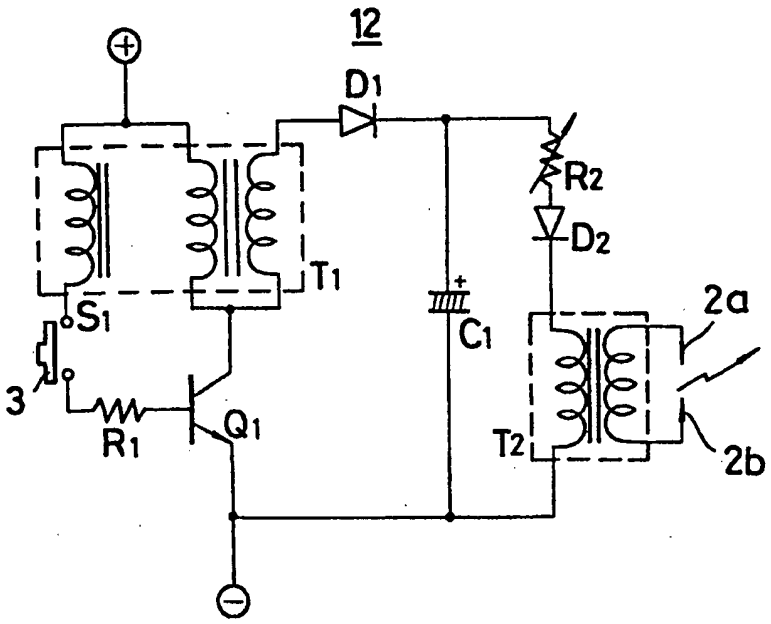


Fig.5

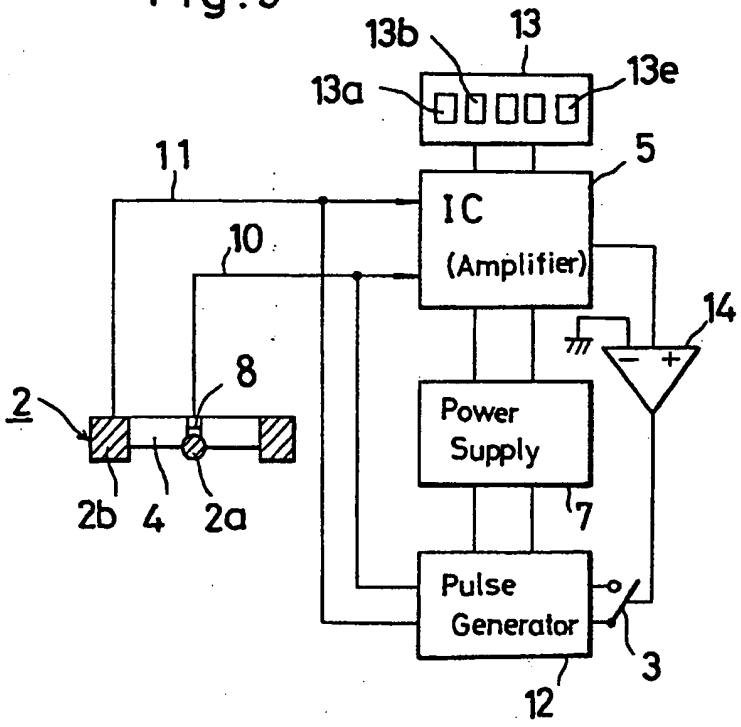


Fig.6

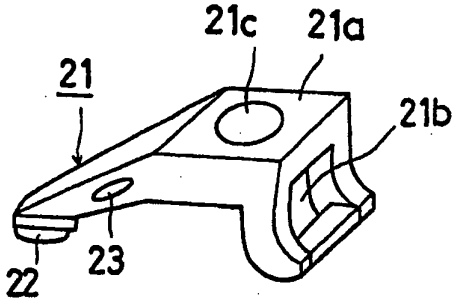


Fig.7

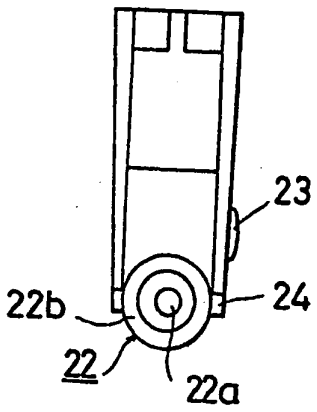


Fig.8

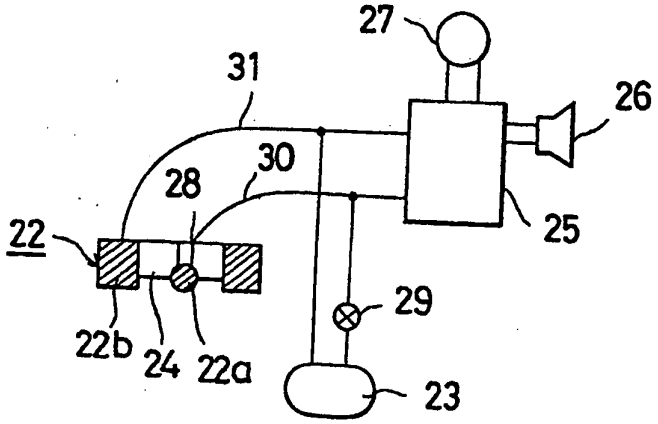


Fig.9

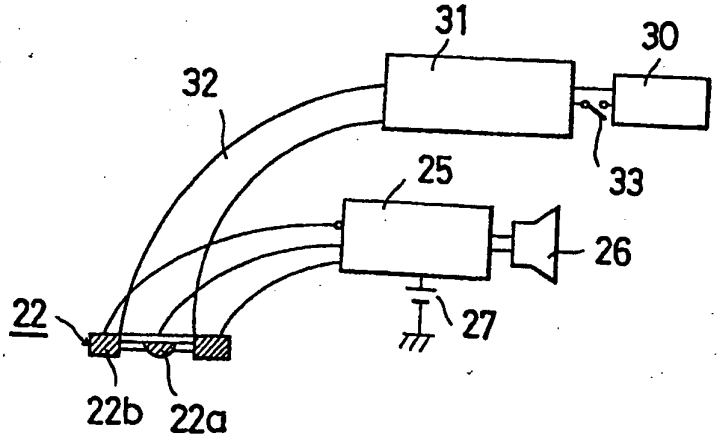


Fig.10

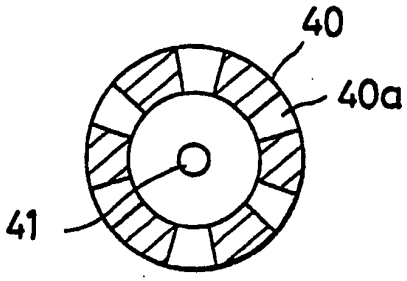


Fig.11

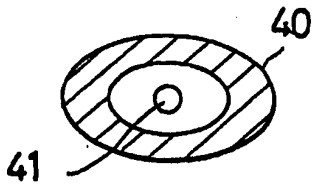


Fig.12

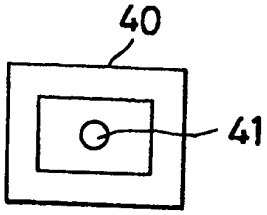


Fig.13

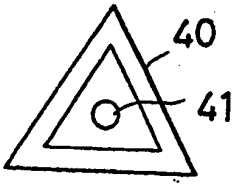


Fig.14

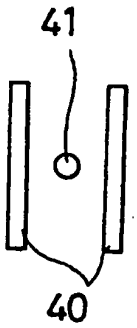


Fig.15

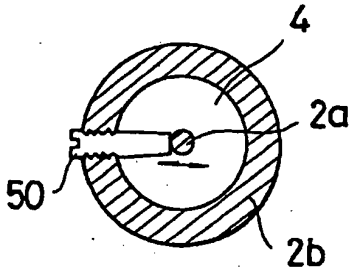


Fig. 16

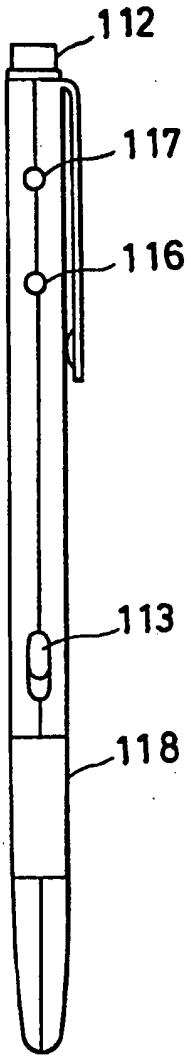


Fig. 17

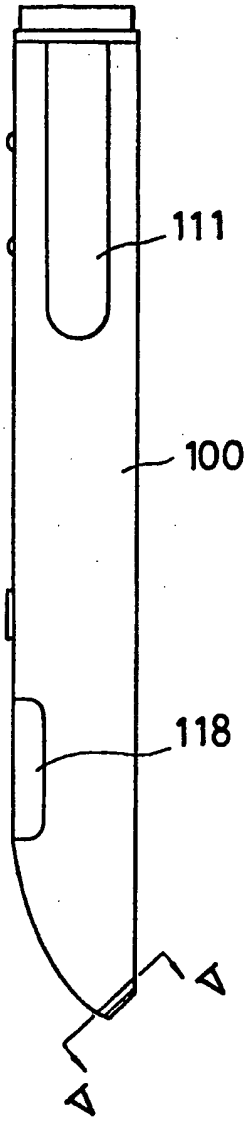


Fig. 18

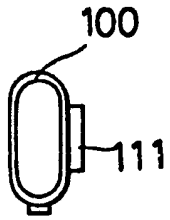


Fig. 19

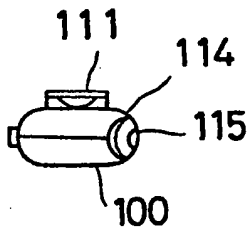
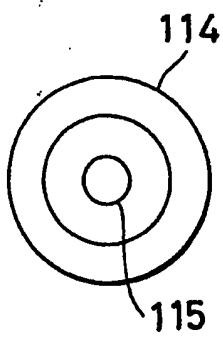


Fig. 20



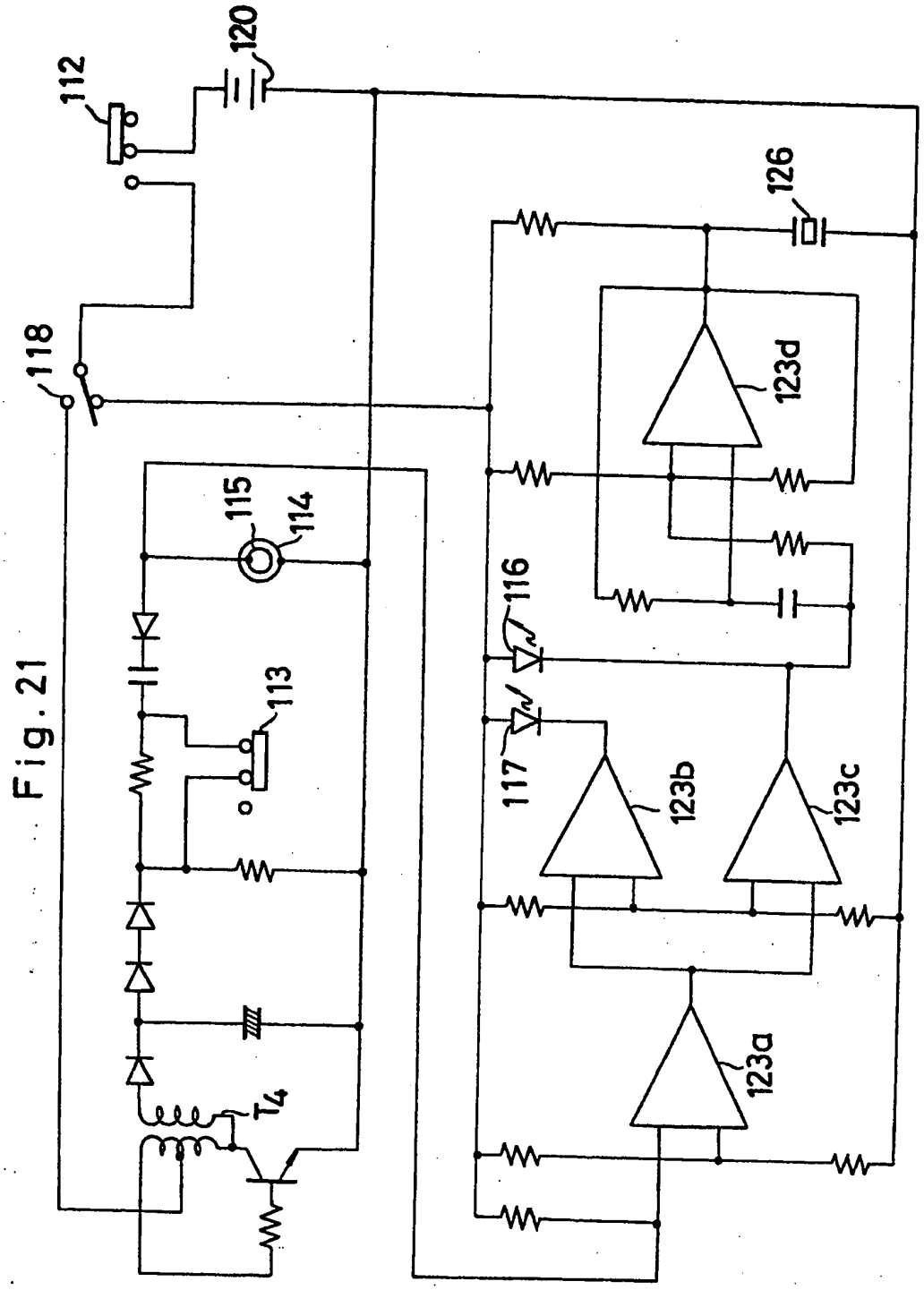


Fig. 21